

# STEM education from the perspective of The University of Sydney STEM Teacher Enrichment Academy

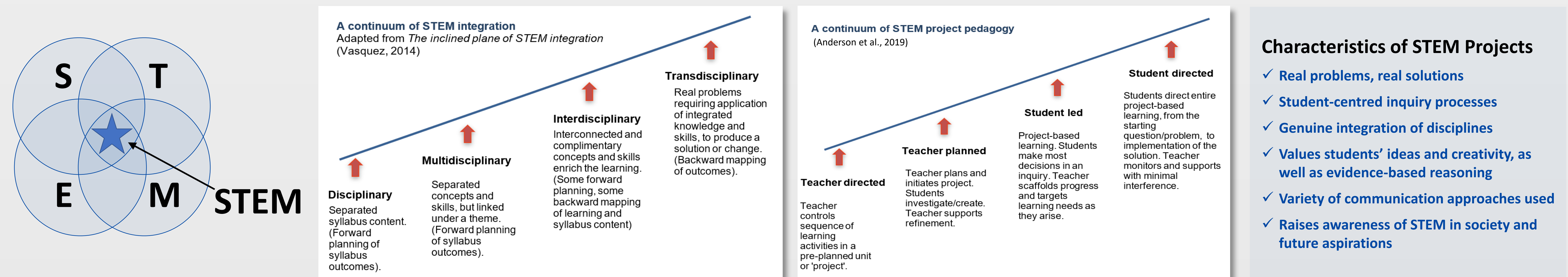
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The Academy is driven by the belief that STEM education is not a 'fad' and has the potential to transform pedagogy, thus motivating and enthusing students to participate more fully in the STEM disciplines, continue into senior secondary STEM subjects and beyond, ultimately addressing a shortage in STEM-related careers.

## What is STEM? Conceptualising STEM in the Curriculum



### Primary Programs

In primary schools, classroom teachers are well connected. A key challenge is teacher confidence in STEM, often leading to hesitation in engaging with the teaching of STEM. Hence, the program is structured as below.

4 teachers per school team | 10 – 12 Partner Schools

**Two-day Professional Learning session (February)** introducing short and repeatable STEM exercises (Level 1 STEM), followed by more substantial tasks to develop design and/or inquiry processes (Level 2 STEM). Teachers experience the activities, building confidence and self-efficacy. The Academy's 3-Level approach scaffolds skills and confidence of both students and teachers.

**Implementation of Level 1 & 2 STEM activities/lessons in schools**, with STEM Academy Mentor support, and an after-school Zoom session where teachers network with the other teams.

**Two-day Professional Learning session (June)** delving into design thinking driven STEM projects. Each school team develops their Level 3 integrated STEM projects, with school context in mind.

**Implementation of Level 3 integrated STEM projects in schools**, with STEM Academy Mentor support, and an after-school Zoom session to connect with community and industry organisations.

**Final showcase and graduation celebration (December)** where schools present their integrated STEM activities and projects, and plans for the following year.

**Community of Practice:** Ongoing support and engagement, mentoring, online forums, newsletters, seminars and events.

### Secondary Programs

In secondary schools, teachers are organised according to subject areas (KLAs). A key challenge is limited opportunity for connection between KLAs for time-poor teachers. Hence, the program is structured as below.

6 teachers per school team | 10-14 partner schools

**Three-day residential Professional Learning session (November/June)** designed to connect the different KLAs, including multi-disciplinary and cross-disciplinary sessions. Teachers experience the ambience of an academic conference, with opportunities to network, develop and plan their schools' implementation of integrated STEM lessons, units and projects.

**Implementation of STEM lessons/units/projects in schools** with STEM Academy Mentor support.

**Professional Learning session (June/November)** where teachers present the outcomes of their work to their colleagues and support each other in planning future STEM units and activities.

**Further implementation in schools** with STEM Academy Mentor support.

**Final showcase and graduation celebration (December/June)** where schools present their integrated STEM work and plans moving forward.

**Community of Practice:** Ongoing support and engagement, mentoring, online forums, newsletters, seminars and events.

#### Data show a significant increase in teacher self-efficacy beliefs

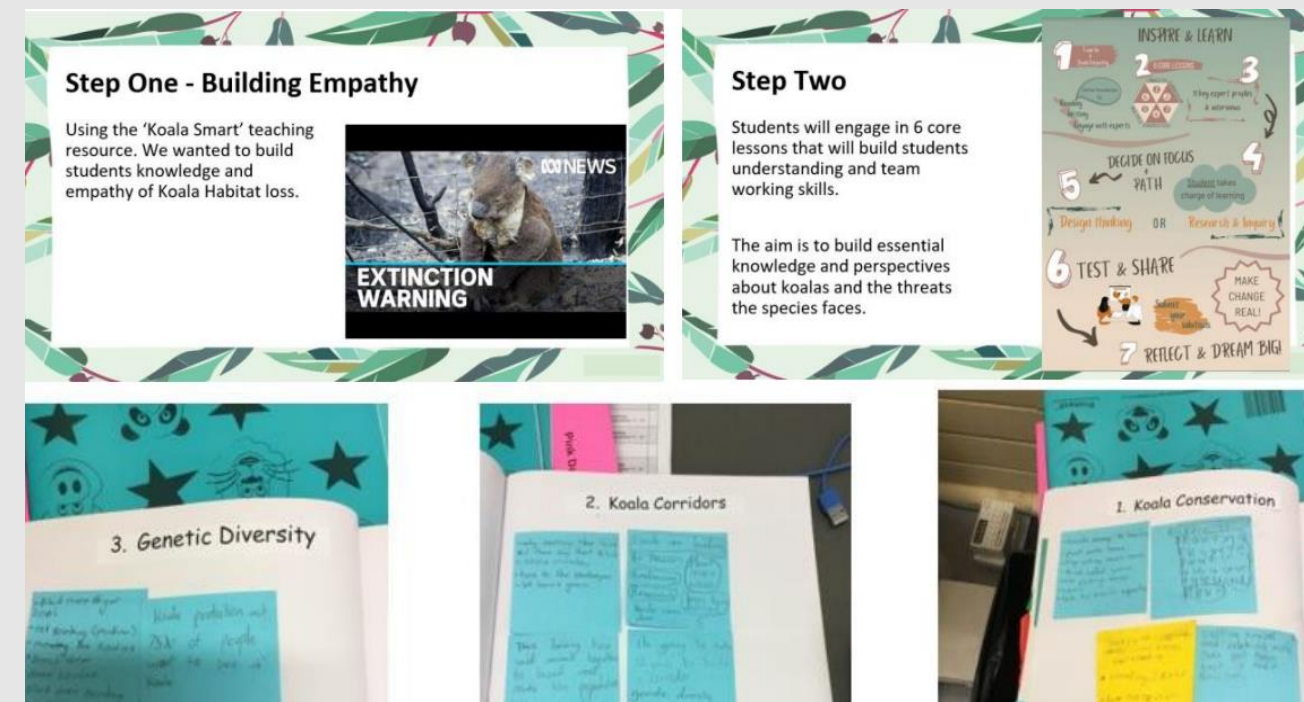
Primary teacher (N=144) gains in self-efficacy was highly significant with a large effect size ( $Z=-7.23$ ,  $p=.000$ ,  $r=.60$ ).

**Teacher 1: Project Save our Koalas  
Koala Warriors for Change**

"[I have] become more confident in delivering and incorporating level 1 and level 2 activities in my everyday teaching practices."

**Teacher 2:** "In the beginning it seemed almost scary... But after that first training day my enthusiasm and eagerness to learn new skills overtook fear and I was eager to try!.. now intend to instruct others in the STEM process, to encourage further ideas that can be implemented by staff and students."

**Teacher 3:** "STEM has always been 'in the too hard basket'... [I] have learnt a lot over the past year including that you do not need a science degree to integrate STEM education into our class learning."

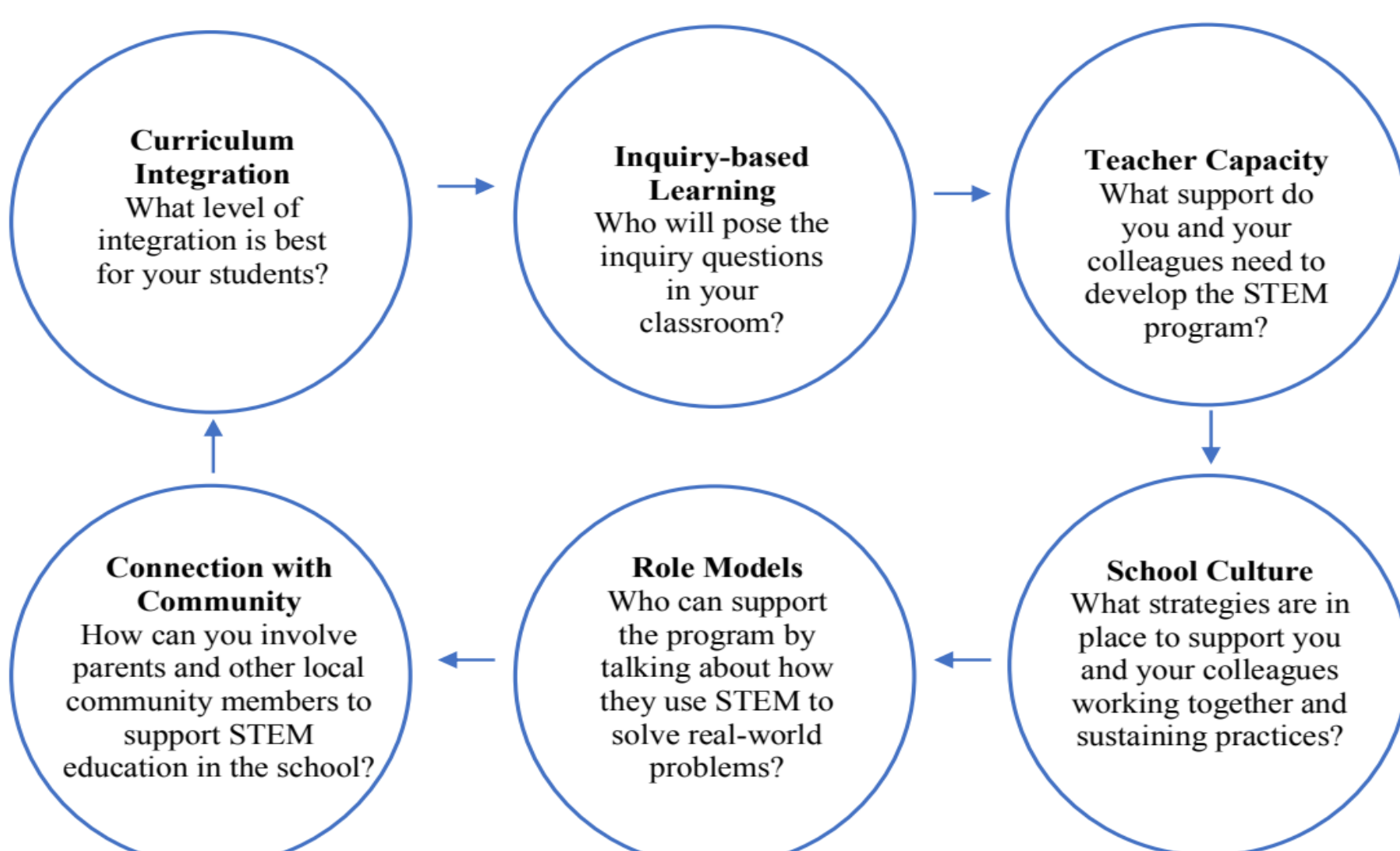


#### Data show teachers are working together, with increased integration and cross-faculty collaboration

**Teacher 1:** "Working in a cross faculty team has been professionally very rewarding and is something I would like to continue my involvement in."

**Teacher 2:** "The profile of STEM has definitely increased within the school as a result of this program. The STEM project and our involvement with the University STEM Academy has provided the opportunity of time to ensure additional collaboration between the faculties resulting in a more comprehensive STEM program. There were more teachers involved in presenting the program to the students than those who were direct members of the Academy program (9 in total) and so we also managed to use the time to brief them on the aims and success criteria for each project. This again reinforced the cross-curricular collaboration and understanding of the wider curriculum for all teachers involved. We previously had several STEM projects that were conducted by individual faculties within the school. The STEM academy helped us find a way that we could implement a STEM program that allowed cross-faculty integration."

#### Proposed model of key characteristics of an effective integrated STEM program (Anderson et al., 2019)



In summary, the STEM Academy programs are evidence-based, with the first secondary program running in 2014 and the first primary in 2017. Currently, there are four year-long programs running, two primary and two secondary programs in both Sydney and a selected regional area. A total of 1170 teachers from 229 schools have graduated from an Academy program. There is robust evidence that there has been an uplift in the profile of STEM within the schools and in some cases the community, with sustained visibility of STEM within school programs. While the influence on secondary students' subject and career choices is difficult to delineate from other confounding variables, some schools have been compelled to offer more STEM related subjects.

Beyond research, Principals from Partner Schools provide unsolicited feedback:

"The learning that has been undertaken and the value it has added to the students curriculum opportunities as well as the development undertaken by our teachers has been outstanding...STEM will now have an ongoing presence...serving to enhance and expand the life opportunities of our students."

"All the seven staff involved, have introduced STEM into the school with enthusiasm and passion. The results... have been nothing but a success. Feedback from the students and the parents has been very encouraging, a majority requesting further sessions."

"Participation has developed confidence in each participant to think strategically. As a team, teachers developed an idea or vision... how they would achieve it. Through an instructional leadership model of gradual release, teachers were able to build the capacity... I have welcomed the new knowledge and insights teachers have gained... teachers were able to develop a deep understanding of the syllabus and its content."

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